



INVESTIGATOR'S ANNUAL REPORT

United States Department of the Interior
National Park Service

All or some of the information you provide may become available to the public.

OMB # (1024-0236)
Exp. Date (11/30/2010)
Form No. (10-226)

Reporting Year: 2007	Park: Shenandoah NP	Select the type of permit this report addresses: Scientific Study	
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Project Title (maximum 300 characters): Linked Hydrologic and Atmospheric Mercury Fluxes in a High-Elevation Wetland			
Park-assigned Study or Activity #: SHEN-00340	Park-assigned Permit #: SHEN-2007-SCI-0010	Permit Start Date: Jun 20, 2007	Permit Expiration Date: Mar 31, 2012
Scientific Study Starting Date: Jun 20, 2007		Estimated Scientific Study Ending Date: Mar 31, 2012	
For either a Scientific Study or a Science Education Activity, the status is: Continuing		For a Scientific Study that is completed, please check each of the following that applies: <input type="checkbox"/> A final report has been provided to the park or will be provided to the park within the next two years <input type="checkbox"/> Copies of field notes, data files, photos, or other study records, as agreed, have been provided to the park <input type="checkbox"/> All collected and retained specimens have been cataloged into the NPS catalog system and NPS has processed loan agreements as needed	
Activity Type: Research			
Subject/Discipline: Wetlands / Floodplains			

Purpose of Scientific Study or Science Education Activity during the reporting year (maximum 4000 characters):

The accumulation of mercury (Hg) in the environment from atmospheric deposition is a worldwide problem that has gained attention relatively recently [Krabbenhoft, 2004]. The form of mercury that is particularly toxic is methylmercury (MeHg), which is formed by the bacterial transformation of ionic mercury (Hg²⁺) and efficiently bioaccumulates in the food chain. It is estimated that

approximately 630,000 children born each year in the U.S. alone are exposed to elevated methylmercury levels in the womb, putting them at risk of impaired neurological development [Mahaffey, 2004]. Only now are we beginning to fully grasp the widespread impact that this problem is having on human health, affecting localities hundreds of miles away from emission sources [Driscoll et al., in press]. Mercury concentrations in the atmosphere have increased 2-5 times those of pre-industrial levels [EPA, 1997] leading to increased deposition. However, it is the transformation processes that occur upon deposition within watersheds that ultimately affect the bioavailability of this toxin. Although the impact of the mercury problem is wide-ranging, the specific processes that control mercury cycling in the environment remain poorly understood.

Statistical relationships between watershed physical descriptors and mercury concentrations are relatively weak, but two key controls are worth noting. First, the degree of watershed forestation is positively related to Hg concentration since trees scavenge Hg vapor through stomatal uptake [Ericksen et al., 2003] and because organic matter is typically abundant in forested systems. Second, watersheds with wetlands tend to have high concentrations of MeHg, since reducing conditions are more favorable in these areas [Grigal, 2002]. Overall, controls on mercury concentrations are quite complex, and high spatial variability can be found within limited geographical areas. For example, preliminary measurements taken in Shenandoah National Park (SNP), Virginia at 15 sites found HgT concentrations to be fairly low, ranging from 0.104 ng/L to 0.651 ng/L. Deviations from these low levels were discovered in the Big Meadows area of SNP, an extensive wetland area that is the location of the proposed research. Here, total mercury concentrations in surface water were much higher, ranging from 1.77 ng/L to 4.66 ng/L [C. Moore., pers. comm.]. These concentrations are consistent with a setting in which bioaccumulation of mercury is a general problem. Streams that drain this wetland area, however, have reduced total mercury concentrations, raising the question of which transformations and fluxes are responsible for dramatically altering the stream mercury concentrations along the hydrological flowpaths within the wetland.

We would like to develop a process-based understanding of how mercury is transformed in natural environments by simultaneously measuring both aqueous and atmospheric fluxes. The large gradient in mercury levels over short distances in the Big Meadows area of SNP provides us with an ideal natural laboratory to understand how mercury moves through the natural environment. The ultimate goal is to scale up this information to predict other areas within SNP that are vulnerable to elevated stream water levels of mercury and mercury bioaccumulation.

Findings and status of Scientific Study or accomplishments of Science Education Activity during the reporting year (maximum 4000 characters):

No activity was conducted this report year. We have received our instruments and are currently testing them in the laboratory, with an intent to deploy them in Spring '08.

For Scientific Studies (not Science Education Activities), were any specimens collected and removed from the park but not destroyed during analysis?

No

Funding specifically used in this park this reporting year that was provided by NPS (enter dollar amount):

\$0

Funding specifically used in this park this reporting year that was provided by all other sources (enter dollar amount):

\$0

List any other U.S. Government Agencies supporting this study or activity and the funding each provided this reporting year:

Paperwork Reduction Act Statement: A federal agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. Public reporting for this collection of information is estimated to average 1.625 hours per response, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms. Direct comments regarding this burden estimate or any aspect of this form to Dr. John G. Dennis, Natural Resources (3127 MIB), National Park Service, 1849 C Street, N.W., Washington, DC 20240.